Reviews and Bibliographical Notices.

I.—The optic nerve. The course of its fibres and their central termination according to recent publications.

A correct knowledge of the topography of the fibres of the optic nerve is a valuable guide in both diseases of the eye and of the brain. The prognosis of affections of the nerve varies with the nature of the lesion, which the oculist can sometimes recognize only by means of proper localization. The diagnosis, on the other hand, of the site of a brain lesion, is facilitated often by perimetric observation of the blindness caused by it. We propose to review in this article the various statements lately published regarding the course of the optic-nerve fibres.

An attempt has been made by Salzer (*Wiener Acad. Sitzungsberichte*, 1880, lxxxi, 3) to count the fibres of the optic nerve. By counting them in a given micrometric space and measuring the whole area of the optic nerve (minus the connective-tissue septa) with a planimeter, 438,000 was obtained as the most probable figure. By a similar procedure, the number of cones in the retina was estimated at 3 to 3.6 millions. This shows that probably about 7 to 8 cones are supplied, on an average, by one nerve fibre. The question, which of the bundles of fibres in the trunk of the optic nerve supply a given area of the retina, can not be solved by anatomical research alone. But by comparing the cross-sections of a partially atrophied nerve at the *post mortem*, with the impaired field of vision observed during life, an answer may be obtained.

But two such observations are as yet reported. Wilbrand and Binswanger (according to Hirschberg's *Centr. f. Augenheilkd.*, July, 1879) have seen an instance of *peripheral* constriction of the field of vision, which the *post mortem* traced to a neuritis

ending in atrophy. The central bundles of the optic nerves, however, were intact; only a peripheral ring underneath the sheath of the nerve was degenerated. Hence, in this case, the periphery of the retina received the peripheral fibres of the optic nerve.

Another instance of retro-bulbar neuritis is reported by Samelsohn, in the *Centralblatt f. d. Med. Wiss.*, No. 23, 1880. There existed during life a central scotoma, involving only the macula. The temporal side of the papilla showed an atrophic discoloration. The fibres supplying the defective macula could be recognized by their degeneration. They constituted an atrophied bundle in the centre of the optic-nerve trunk when examined at the optic foramen. The atrophy, perfectly symmetrical in both nerves, had not extended upward beyond the optic foramen. But in its course toward the eye, the atrophied bundle passed toward the temporal side of the trunk, and beyond the entrance of the central vessels it was found in the form of a wedge with its apex near the centre and its base not quite reaching to the temporal periphery. Both reports, hence, show that in the cross section of the nerve the fibres occupy about the same topographic relation as the retinal elements which they supply. Samelsohn points out, that in harmony with the superior dignity of the centre of the retina, the fibres innervating the macula (atrophied in his case) amounted to one-half of the entire nerve.

The most interesting part of the optic nerve is the chiasm. Whether this formation is due to a total crossing of the fibres of one optic tract to the nerve of the other side, or to a semi-decussation, is yet a question considerably agitated. All evidence, however, points to the latter view. In fishes, the interlacing of the fibres in the chiasm is either absent, or so simple that a complete crossing can be proven beyond doubt. But in all higher animals, there exists such an intricate interlacing of the two nerves that, according to observers like Meynert and Gudden, microscopic observations cannot decide the point. Recently, however, Stilling again reported at the Ophth. Congress at Milan, that he had followed the fibres with the naked eye. (*Centralbl. f. Nervenheilkd.*, No. 22, 1880.)

After hardening of the human chiasm in Müller's fluid and in alcohol, it was macerated in pyroligneous acid and then teased. He claims to trace thus both the decussated fibres and a bundle, equally large, of direct fibres. The latter are said to surround the crossing fibres. He claims, likewise, the existence of an an-

terior commissure uniting the two eyes. This formation no other modern observer has recognized.

Attempts have been made to test the semi-decussation experimentally. If the chiasm is divided by a longitudinal median incision, complete blindness necessarily indicates a total crossing of all fibres. Such was really the result in the older experiments of Beauregard and of Brown-Sequard. The former used pigeons. The latter does not state the kind of animal employed, but they were probably guinea-pigs or rabbits. But in all such researches the view of J. Müller must be used as a guiding star. This great physiologist predicted that the completeness of the decussation depends inversely upon the fusion of the two fields of vision, or, in other words, upon the angle included between the two orbits. The larger the common field of vision of the two eyes, the more voluminous must we expect to find the bundle of optic-nerve fibres, which does not decussate. In harmony with this view are the results of Nicati on the cat, an animal whose eyes have at least a partial field of vision in common. He perforated the base of the skull from below, and bisected the chiasm longitudinally. As he reported to the Paris Academy of Science (June 10, 1878), this operation does not render the animals blind. This fact alone establishes the semi-decussation in the cat.

The attempts have been more numerous to trace the fibres through the chiasm by means of a partial atrophy. Extirpation of the eyeball in a new-born animal simply prevents the further development of the corresponding nerve fibres. If the extirpation is performed some days or weeks after birth, atrophy of the fibres sets in in the course of several months. This atrophy occurs also in the human subject, but requires, evidently, several years for its completion, even if the eye is lost during childhood. Atrophy can likewise be produced, even more definitely, when the central termination of the nerve is destroyed in young animals.

Amongst the most fervent defenders of the semi-decussation is Gudden, whose articles are to be found mainly in the *Archiv f. Ophth.* (the most recent being xxv, 1, p. 1, and xxv, 4, p. 237). Pursuing his researches during many years, he has recently found that even in the rabbits, although there seems to be no common field of vision, there exists a small direct bundle. It could be demonstrated by destroying the central end of one optic tract or removing both tract and nerve of one side by cutting through the chiasm. In the course of six months the corresponding nerve

had atrophied completely, with the exception of a slender uncrossed fasciculus. In the dog the bundle of direct fibres is of larger size, though smaller than the decussating fasciculus. After the production of atrophy from either central or peripheral lesion the persistence of this fasciculus can be demonstrated amidst the other degenerative fibres. It can likewise be learned that the atrophy due to extirpation of the eye extends into both optic tracts, though the opposite one is more involved on account of the greater number of crossed fibres. These statements are contradicted by Michel, but in an untrustworthy manner (*Archiv f. Ophth.* xxiii, 2, p. 227). Some of his errors are due to a misunderstanding of the commissures included in the chiasm. Gudden describes them as follows: The commissure known under Meynert's name is to be found on the upper (dorsal) side of the chiasm, thence following the optic tracts toward the peduncle. In the rabbit it can be recognized most easily, though microscopically its course is seen to be the same in man and the dog. Behind the chiasm it moves toward the upper (dorsal) and median border of the tract, and can here be usually recognized, though covered with a thin layer of gray substance. It finally leaves the optic tract and dips down between the bundles of the pes pedunculi.

According to Gudden there exists, further (in man and mammalia), a strand of fibres on the upper (dorsal) side of the tractus opticus, in contact with, but distinct from, Meynert's commissure. The direction of the fibres is nearly transverse and they are ultimately lost in the substance of the tuber cinereum. Their morphological significance was not ascertained. A third commissure, called by Gudden c. inferior, runs toward the rear from the chiasm along the upper inner border of the tracts. It is so closely connected with the optic tract that it cannot be recognized separately. It can be easily demonstrated by enucleation of both eyes. The subsequent atrophy invades all fibres except the commissure. In the rabbit it can be recognized in a cross section of the normal optic tract by its relatively fine fibres, while in this animal the optic tract itself consists of coarse fibres.

One of the clearest descriptions of the human chiasm in case of atrophy is given by Kellerman (Zehender's Klin., *Monatsbl. f. Augenheilk., Ausserordentliches Beilageheft*, xvii, 1879). A patient who had lost his left eye by an accident in his third year died at the age of 40 with phthisis. The left eye was completely shrunken, and the nerve of that side totally atrophied. The right eye was

normal, but in its nerve there was found a small bundle, showing a descending atrophy which had not quite reached the eyeball. This bundle was found in the more central part of the nerve, below the centre, but near the eye it gained the temporal periphery. Its significance was not learned. In the chiasm it could be seen that about two-thirds of each nerve crossed into the tract of the other side. The decussation occurred mainly in extensive arcs. In the nerves the direct bundles are situated on the external side, but in the optic tract the intermingling was so complete that Kellerman could not trace them as separate fasciculi.

In another case, reported by Baumgarten (*Centralblatt f. d. Med. Wiss.*, 31, 1878), the topography of the optic tracts was different. At the *post mortem*, seven years after enucleation of the right eye, the right nerve was found completely atrophied. Degenerated fibres were found in both tracts to the extent of several millimetres beyond the chiasm. In the tract of the same side, the atrophied (direct) fibres existed mainly along the upper part of the periphery, less so in the upper external portion, while the crossed degenerated fibres were found in the other tract in the lower inner quadrant.

In the same number of the *Centralblatt*, Gowers reports, likewise, a case of ascending atrophy of one nerve extending into both optic tracts. Two further cases of atrophy of one nerve extending into both tracts were reported by Schmidt-Rimpler to the German Ophthalmological Society (1877). In his last articles, Gudden likewise details three instances of this nature, in which careful measurement showed the involvement of both tracts. All these cases prove that the crossed bundle in man is more voluminous than the direct fasciculus. At the last International Ophthalmological Congress at Milan (*Centralbl. f. Augenheilk.*, Nov., 1880), Purtscher reported six more cases of one-sided atrophy of the optic nerve, confirming, in all details, Gudden's views as regards the semi-decussation and the existence of an inferior commissure. In two cases of bilateral atrophy of optic nerves, Purtscher found intact only the inferior commissure of Gudden, and a few narrow strands of normal fibres in the midst of the degenerated tracts. These strands represent, probably, another commissure.

The semi-decussation of the optic nerves is also proven by a number of cases in which the hemianopsia existing during life was explained by the lesion found at the *post mortem*.* The most

* The term hemianopsia, introduced by Hirschberg, is preferable to the former word, hemianopia, since it signifies, in an unmistakable way, blindness toward one side,—loss of one-half of the field of vision.

instructive cases in which the lesion was found involving the visible part of one optic tract are the following :

Hughlings-Jackson (*Lancet*, May, 1875). Left-sided hemianopsia, hemiplegia and hemianæsthesia, caused by softening of the posterior half of the right thalamus. No other brain lesion.

Hirschberg (*Virchow's Archiv*, Bd. 65, p. 116). Right-sided hemianopsia, caused by gliosarcoma in the left frontal lobe of the cerebrum, the left optic tract being thinner than the right.

Pooley (Knapp's *Archives of Ophth. and Ot.*, v, 2, p. 148). Right-sided hemianopsia, due to a tumor in the left posterior lobe of the brain, and softening of the surrounding region, especially the left thalamus opticus.

Gowers (*Centralblatt f. d. Med. Wiss.*, 31, 1878). Left-sided hemianopsia. A small tumor in the inner and lower part of the right temporo-sphenoidal lobe, involving the optic tract, and extending into the crus cerebri. Degeneration of the right optic tract. The left tract and both optic nerves were normal.

I. Dreschfeld (*Centralblatt f. Augenheilk.*, February, 1880). Left hemianopsia, produced by a tuberculous tumor, extending along the outer lower side of the right thalamus opticus, and crowding that structure out of place and compressing the right optic tract. In another instance reported by the same author, a carcinomatous tumor, pressing on the right side of the chiasm and surrounding the right optic nerve, had produced temporal (left) hemianopsia of the left eye, but complete blindness of the right eye. On account of the position of the tumor, the case is, hence, not absolutely convincing. Similar doubts are permissible in the following instances :

Hjort (*Klin. Monatsbl. f. Augenheilk.*, v, 1867, p. 166). Left-sided hemianopsia of the left eye, but complete amaurosis of the right eye. The *post mortem* showed tubercles in the pia mater, also a few at the convexity of the cerebrum. A tuberculous tumor of the size of a hazel-nut was found in the right half of the chiasm.

Mohr (*Arch. f. Ophth.*, xxv, 1, p. 57). Left-sided hemianopsia of the right eye, but amblyopia of the left eye. The autopsy showed two cysts on the median side of the left optic thalamus, and a tumor of the size of a walnut pressing on the chiasm and left optic nerve. The real importance of the case is to be sought in the complete degeneration of the left optic tract, proving that the intact temporal half of the right retina received its fibres from the optic tract of the right side.

Even if the evidence of some of the last cases is considered

doubtful, the first instances quoted decide absolutely that the human chiasm represents a semi-decussation, and that each optic tract supplies the temporal half (*i. e.*, the smaller portion) of the retina of the same side and the nasal half of the opposite retina. In most of the cases the line separating the sensitive half of the retina from the blind area passed vertically through the point of direct vision. Hence each macula receives fibres from both optic tracts, which fibres remain on the corresponding side.

In cases of homonymous hemianopsia, the lesion must, hence, be referred to the optic tract of the side of the blind half of the retinæ. It may be situated anywhere in the rear of the middle of the chiasm, either in the exposed portion of the tract or in its concealed course, between its origin—the cerebral cortex—and its emergence at the base of the brain. The exact location can be diagnosed only by interpretation of other accompanying brain symptoms which, in the above cases, we omitted as irrelevant. Further instances of hemianopsia, due to cortical lesions, will be referred to for demonstration of the origin of the optic tracts.

With the exception of Stilling, no recent author has attempted to trace the roots of the optic nerve. Stilling read the following résumé of his reseaches at the meeting of the German Ophthalmological Society in 1879 :

"The optic tract, as it approaches the optic thalamus, divides into two branches, which pass separately to the external and internal geniculate bodies. At the place where these branches separate a third branch can be detected, which joins the anterior brachium conjunctivum, and reaches with it the corpora quadrigemina. At this place the fibres subdivide. A part of them passes over the superior (anterior) corpus quadrigeminum, and forms a commissure with the fibres of the other side; while another part spreads along the surface of this body and thence pursues a backward direction. The greater portion, however, enters directly the gray substance. The two corpora geniculata, hitherto called the points of origin of the optic nerve, are in reality but its ganglia. The fibres only surround and include the geniculate bodies, and thence pass, at least to a large extent, to the surface of the optic thalamus, where they form a layer of fibres. This arrangement had, indeed, been recognized by Reil many years ago. Some of the fibres pass around the external geniculate body, and terminate in the thalamus opticus. A third strand perforates the external corpus geniculatum to reach the thalamus. The medullary streaks of the geniculate body are, indeed, but the plates

of nerve fibres from the optic tract, between which ganglionic cells are deposited.

A deep horizontal section through the optic tract and foot of the peduncle shows a fourth branch of the optic tract entering between the fasciculi of the pes pedunculi. In some cases the fibres of this root radiate gradually into the substance of the peduncle. In other more demonstrative instances the root forms a distinct strand, separating itself from the rest of the optic tract and dividing into numerous fasciculi, which dip in between the bundles of the pes pedunculi. This root reaches and terminates in an almond-shaped gray nucleus situated below the substantia nigra, underneath the "red" nucleus of the tegmentum pedunculi. This body had been described by Luys as the "bandelette accessorie de l'olive superieure." Forel has termed it the nucleus of Luys. It seems almost, from this description, that the root described by Stilling is not at all an integral part of the optic nerve, but really the commissure of Meynert.

Stilling further describes a conical root arising from the tuber cinereum. Again, it must be doubted whether this is really a part of the nerve or the strand described by Gudden. Stilling refers to Gudden's former observations. In his recent article the latter showed, however, that this strand (perhaps a commissure) does not atrophy when the rest of the nerve degenerates in consequence of enucleation of the eyes. Finally, Stilling claims that another origin of the nerve is to be found in the substantia perforata antica. He details thus seven different points of origin, viz. : the branch from the optic thalamus through the external geniculate body ; the branch from the internal geniculate body ; the superficial branch in the corpora quadrigemina ; the nucleus in the pes pedunculi (?) ; the tuber cinereum (?) ; the substantia perforata antica, and the surface of the thalamus opticus.

At the meeting of the International Ophthalmological Congress at Milan (1880), Stilling demonstrated also the existence of a "spinal" root of the optic nerve (*Centralblatt f. Nervenheilk.*, Nov., 1880, p. 474). This root proceeds from the external geniculate body in a half spiral turn, and enters in a radiating manner the pes pedunculi. The author traced it in the macerated specimen through the pons into the medulla oblongata. He points out how the existence of this root can explain the mysterious connection between diseases of the optic nerve and affections of the medulla.*

* The last number of Hirschberg's *Centralbl. f. Augenheilk.* (December)

In a previous article (*Centralblatt f. Augenheilk.*, Feb., 1879) Stilling had shown the importance of the occipital lobe as a visual centre. In large cross sections it can be seen that numerous fasciculi pass from the optic thalamus into the medullary substance of the occipital lobe (previously described by Gratiolet).

Pathological observations have as yet contributed nothing to our knowledge of the topography of the optic roots in the interior of the brain. In the few instances which have been reported, the lesions were too extensive to allow of any conclusion. But evidence is gradually accumulating as regards the location of the visual centre in the cortex. Cases of atrophy of certain convolutions, following loss of one eye, are by far the most conclusive.

Huguenin has reported the following observations in the *Correspondenzblatt f. Schweizer Aerzte*, Nov. 15, 1878. A man, who had lost the left eye in his third year, died of pneumonia at the age of 56. Left optic nerve thin and atrophied; the right one normal. Left optic tract about one-half the size of the right tract, which is of normal size. Left pulvinar smaller than the right one; the corpora quadrigemina also much smaller on the left than on the right side. A similar difference in the size of the two external geniculate bodies, with absence of the superficial fibres derived from the optic tract on the left side. The two internal geniculate bodies alike in size. A noticeable atrophy in the cortex of both occipital lobes around the occipital fissure, where it passes from the median surface over on the convexity of the cerebrum. The atrophy is more marked on the right (opposite) side. The convolutions are thinned, and the sulci widened. The atrophy extends down also on the median side of the hemispheres, but not as far as the sulcus hippocampi.

The second autopsy was made on a woman of 42 years, dead of typhus, who had had small-pox during youth, and was nearly blind in both eyes. Both optic nerves equally and considerably thinner than normally, likewise the two tracts. The two pulvinaria also seem reduced in size. The corpora quadrigemina are flat-

contains a further report by Stilling. He describes a second spinal root, consisting of a large number of bundles, which leave the optic tract to reach the inner surface of the internal geniculate body, whence they pass, in a half-spiral turn, underneath the bracchium conjunctivum posticum and join the lemniscus. Between the bundles of the latter they can be traced to the inferior olivary body. Other bundles, which at first pursue the same course, terminate in the nucleus of the motor oculi nerve. The latter discovery is an important confirmation of a physiological desideratum, whereby the path of reflexes passing from the optic nerve to the motor nerve of the iris is defined. Stilling has finally traced other bundles into the crus cerebelli ad corpus quadrigeminum and thence into the cerebellum.

tened, and the external geniculate bodies small and gray, on account of atrophy of the superficial fibres. In the cortex of the occipital lobes the atrophy, equal on both sides, invaded the same region as in the first case.

A similar instance is reported by Burkhardt in the report of the institution Waldau for 1879 (according to the *Centralblatt f. Nervenheilk'd*, 1880, Sept., p. 361). A man of 22 years had lost the right eye during youth, probably by injury. The left eye had a small central capsular cataract with fair sight, but there existed nystagmus. At the *post mortem* (death by purpura hemorrhagica) the convolutions were found well developed, but the gyrus angularis of the left side was smaller and less distinct than the corresponding part of the right hemisphere. A similar distance was observed in the precuneus of the two sides, the right one being the smaller.

The last case is evidently of less significance. It cannot be said what influence the imperfection of the left eye exerted, and the cortical region, moreover, is not the one toward which most clinical evidence points, though in agreement with Ferrier's experiments. But the first of Huguenin's examples demonstrates conclusively both the cortical centre and the semi-decussation. Instances of hemianopsia due to cortical lesion are more numerous in literature, but rarely, however, was the lesion so distinct and small as to equal in demonstrative value the cases of ascending atrophy.

Omitting various complicated cases with multiple lesions in different parts related to the optic tract, the following résumé is a complete list of all records which could be found :

Wernicke (quoted by Foerster in *Hand. b. d. ges. Augenheilk'd*, vii, p. 118). Right-sided hemianopsia, of sudden origin, with peripheral constriction of the remaining field of vision. Death in twenty months. A foyer of softening in the convexity of the left hemisphere, in a part of the occipital lobe corresponding to the operculum of the monkey. The spot extended backward two centimetres from an ideal continuation of the sulcus parieto-occipitalis. Above it reached the sulcus interparietalis ; it extended forward up to the turn of the first temporal convolution around the fossa sylvii, and downward to the sulcus between the first and second temporal convolutions. In the white substance it extended to the middle of the gyrus postcentralis.

Baumgarten (*Centralbl. f. d. Med. Wiss.*, 1878, No. 21). Sudden left-sided hemianopsia, with sharp line of demarcation through the point of direct vision. Sight and color-sense of the intact ret-

inal half were normal. Death, after several months, from kidney-disease. Apoplectic cyst of the size of a walnut in the right occipital lobe, comprising the three gyri occipitales. It did not quite extend down to the cavity of the right posterior ventricular horn. A second pea-sized spot of red softening in the roof of the left anterior horn, and a smaller apoplectic cyst in the centre of the right optic thalamus. Optic tracts, nerves and chiasm normal.

Jastrowitz (*Centralblatt f. Augenheilk'd*, 1877, p. 254.) Right-sided hemianopsia due to a gelatinous sarcoma in the occipital convolutions and precuneus, with softening in the circumference not attaining the optic thalamus. Optic nerves, tracts and chiasm normal.

Hosch (*Schweiz. Correspondenzbl.*, Sept. 15, 1878, p. 554). Left-sided hemianopsia after apoplexy. Death after three years. Atheromatous condition of the cerebral arteries, multiple miliary aneurisms on the convexity of the brain. In the left parietal lobe a small exudation at the convexity and a small brown cicatrix in the white substance. Recent apoplexy on the left side of the third ventricle evidently the cause of death. All the other lesions were on the right side, in the region of the visual centre, viz.: large cavity due to the the destruction of the greater part of the right occipital lobe; in the region of the corpus striatum a large pigmented cicatrix extending into the right thalamus. Atrophy of the inner bundles of both optic nerves in front of the chiasm. The multiplicity of the lesions deprives the case of much of its value.

Nothnagel (*Topische Diagnostik*, 1879, p. 389). Right-sided hemianopsia, apparently with gradual diminution of sight, which was difficult to determine on account of the mental state. Death after some months. Lesions on the right side of the brain consist in softening of the middle third of the anterior and posterior central convolutions, extending down to the centrum semi-ovale, likewise of a portion of the superior parietal lobe and circumference, and of the third occipital convolution. On the left side were found two patches of softening in the temporal and parietal lobes and total destruction of the occipital lobe. Again no definite conclusion can be arrived at on account of the multiplicity of the lesions.

If we compare these pathological observations with experimental results on animals, a certain agreement is evident. Ferrier in his earlier observations claimed that destruction of the gyrus

angularis caused merely blindness of the opposite eye in all animals examined, including monkeys. He has now modified these statements. At the meeting of the British Association in Cambridge (1880) he reported the results of limited extirpations of cortical centres undertaken with Dr. Yeo. By means of antiseptic dressings the monkeys recovered quickly, and could be kept alive permanently (preliminary account by Pierson in the *Centralblatt f. Nervenheilk'd*, Oct. 1, 1880, p. 393). He claims that the occipital lobes can be removed completely without blindness if the lesion does not extend beyond the parieto-occipital sulcus. Extirpation of the angular gyrus of one side causes a complete blindness of the eye of the other side, which disappears in some hours. The restitution of sight does not depend on the integrity of the cortex of the other side, since subsequent destruction of the other angular gyrus causes either no blindness at all or but a transient trouble. Simultaneous destruction, however, of both angular gyri gave rise to a complete blindness, lasting three days, with imperfect recovery of the sight. Hemianopsia can be caused by destruction of the angular gyrus and occipital lobe of one hemisphere, the retinal halves of the same side being the parts involved, but even this lesion is but transient in its effects in the monkey. Ferrier states even that full sight will ultimately be regained if both occipital lobes and the gyrus angularis of one side be destroyed, as long as only one gyrus angularis remains intact. Destruction, however, of these parts in both hemispheres leads to irreparable blindness without impairment of other senses.

An interpretation of these results seems as yet scarcely possible. They are, moreover, at variance with the experiments of Munk, although Ferrier has, in his last statement, allowed (with Munk) some importance to the occipital lobes as visual centres. Ferrier's claims regarding the rôle of the gyrus angularis have received some support by observations made by Fürstner and reported at the meeting of southwest German neurologists at Heidelberg in 1879 (*Centralblatt f. Nervenheilk'd*, June 1, 1879).

On extirpating the left eye of some new-born puppies, he found, after the lapse of seventeen weeks, atrophy of a spot in the second longitudinal convolution of the right hemisphere, corresponding to the angular gyrus of the monkey. However, it must be remembered that the recognition of partial atrophy in the cortex without microscopic change is a matter of individual judgment. Caution, moreover, is not out of place, when we remember that the semi-decussation in the dog is definitely proven.

Munk's experiments on monkeys have not been very numerous, but they are stated in a very definite way. He denies all importance of the gyrus angularis for visual purposes. A suggestion he makes may indeed serve to explain Ferrier's contrary results. According to Wernicke, the corona radiata, uniting the ganglia of the optic nerves to the occipital lobes, passes underneath and close to the gyrus angularis. Hence any deep extirpation would involve these fibres. Evidently not all the uniting fibres take this course, since destruction of both angular gyri does not produce permanent blindness. Munk claims that only the occipital lobes, but these in their entire extent, represent the visual centre. Each hemisphere controls both retinæ in the monkey in such a manner that the external half of the occipital lobe represents the temporal half of the retina of the same side, while the median part of the occipital lobe receives the fibres coming from the internal half of the other retina (Verhandl. d. Berlin. phys. Ges. in *Archiv f. Anat. & Phys.*, 1878, i and ii, p. 168, and 1880, iv and v, p. 149). In monkeys, therefore, destruction of one occipital lobe causes permanent hemianopsia.

The experiments of Munk on dogs are more complete (*Arch. f. Anat. and Phys.*, 1878, pp. 162, 547 and 599; 1879, p. 581).

The most marked visual disturbance was found on extirpating a relatively small spot near the upper posterior apex of the occipital lobe. While the eye of the same side appeared normal, the animal had lost the use of the other eye almost completely. It could still see with the eye opposite the site of the lesion, but failed to interpret the visual impressions. The sight of that eye improved gradually, but never became normal. Munk called this trouble "psychic blindness," but admits, in his last memoirs, that it can be explained by the assumption that this cortical spot corresponds to the retinal macula, or at least the spot of direct vision. The animal, hence, retains only the use of the peripheral and less sensitive part of that retina. Munk denies, however, that the simple supposition of blindness in the centre of the retina will account for the phenomena; he still insists on psychic blindness under these circumstances, due to loss of visual remembrances. Further experiments showed him that in the dog also each hemisphere represents parts of both retinæ. The direct fibres, however, supply the extreme temporal portion of the retina of the same side, the extent and sensibility of which are so slight that its integrity is easily overlooked when the rest of that retina is blind. These fibres terminate in the extreme external part of the occip-

ital lobe of the same side. The greater internal part of the cortical centre sends its fibres to the retina of the other side, with the exception of its temporal periphery. The topographical representation of the retina in the visual centre is such that the upper periphery of the retina is represented by the anterior border of the occipital lobe, the lower retinal area by the posterior part, and each lateral retinal border by the cortical margin of the corresponding side. In the dog, hence, the retinal spot of sharpest vision receives its fibres from the cortex of the other side; the hemianopsia, therefore, caused by one-sided destruction, is difficult to detect. Munk claims that the effect of all extensive lesions of the cortical centre is permanent, though difficult to detect after a time on account of the adaptation of the animal by the movements of its eyes.

Lastly, the results of Luciani and Tamburini must be mentioned, which are again at variance with the above statements (Riv. sperim. di frenatria, 1879, 1 and 2, quoted in *Centralbl. f. Nervenheilkd.*, October, 1879). As regards the monkey, they have found that the entire occipital lobe is concerned in vision, and not merely the angular gyrus.

They admit the semi-decussation in the monkey, having seen hemianopsia produced by one-sided destruction. In the dog the visual centre is located by them in second (upper) longitudinal convolution from the front to the rear. Destruction of this region on one side causes, as they observed, nearly complete blindness of the other eye, and slight amaurosis of the same side. They claim that these results are not permanent, but compensation is effected by vicarious activity of the unmutilated remnants of the centres, especially the one of the other side. Finally, they refer to an experiment upon a monkey, in which removal of both angular gyri and both occipital lobes permitted a moderate recovery of sight. Of the various experimental results, those obtained by Munk are brought forth in the most trustworthy manner; and whether or not we accept Munk's explanation, they agree best with pathological observations on man. [H. GRADLE.]

II.—On the use of the cold pack followed by massage in the treatment of anæmia. By MARY PUTNAM JACOBI, M.D., and VICTORIA A. WHITE, M.D. New York: G. P. Putnam's Sons, 1880.

This work is a practical contribution to scientific therapeutics. It consists of three articles originally contributed to the *Archives*